

### REMARKS

Reconsideration is respectfully requested in view of the foregoing amendments and the following remarks.

The claims presently pending in the application are 1-12, inclusive. By this amendment applicants have amended claims 1-4, 6-8 and 10.

Claim 1 now recites the limitation "the precipitate of step (i)" at line 8. In view of this amendment the rejection under section 112, second paragraph, has been overcome and should accordingly, be withdrawn.

Before addressing the prior art rejections, applicants believe it would be beneficial to set forth the nature of their invention. The present invention relates to an environmentally benign process for the *simultaneous* preparation of nanocrystalline anatase titanium dioxide and hydrazine monohydrochloride, in substantial quantities from an acidic aqueous titanium tetrachloride solution by reacting with hydrazine monohydrate at ambient conditions of temperature and pressure. The present claims recite the simultaneous preparation of the nanocrystalline anatase titanium dioxide powder having a particle size in the range of 1 to 5 nm with a surface area in the range of 200-250 m<sup>2</sup>/g and hydrazine monohydrochloride, which is achieved by (i) adding hydrazine monohydrate solution drop wise to an acidic aqueous solution of titanium tetrachloride at and (ii) filtering the precipitate of step (i) to obtain titanium dioxide having a particle size in the range of 1 to 5 nm and optionally freeze drying the filtrate to obtain hydrazine monohydrochloride. Special attention should be paid to the fact that the TiO<sub>2</sub> nanoparticle synthesis, as recited in Claims 1-12, is carried out at a temperature in the range of 20-45°C, which also includes ambient conditions, without any further temperature treatments above 45°C, as are required in processes involving calcination or annealing.

Claims 1-6, 8 and 10-12 stand rejected under 35 USC 102(b) as anticipated by or, in the alternative, under 35 USC 103(a) as obvious over the 2002 article by Reddy entitled “Bandgap Studies on Anatase Dioxide Nanoparticles”. Claims 1-6, 8 and 10-12 also stand rejected under §102(b) and §103(a) over Reddy et al.’s 2001 article. This rejection is respectfully traversed.

In both of the Reddy et al. references relied upon by the Examiner, titanium hydroxide was obtained, as can be seen from the IR studies, which upon subsequent drying and calcining resulted in titanium dioxide.

By contrast, in the claimed process, titanium dioxide is obtained *directly* from a titanium tetrachloride precursor, without any calcination steps.

The controlled process conditions recited in claim 1 herein, such as the concentration of the starting precursor acidic titanium tetrachloride in water and the concentration of hydrazine hydrate, are critical to applicants’ obtaining the claimed titanium dioxide nanoparticles directly, without the intermediate formation of titanium hydroxide and the subsequent requirement for heat treatment to form titanium dioxide.

With regard to the temperature of addition of the hydrazine monohydrate, claim 1 specifically recites that its addition must occur at a temperature in the range of 20 - 45°C. This range may or may not be the ambient conditions reported by Reddy et al., which is not clearly identified or disclosed.

In the Office Action the Examiner states that while the Reddy references do not expressly state the surface area of the titanium dioxide product, the Examiner maintains that they are inherently the same size since the process is the same. This most certainly is not the case! The claimed product is obtained through a process, as recited in claims 1-6, 8

and 10-12, which involves neither the process steps of calcination nor of annealing in air and/or nitrogen as disclosed and taught by the Reddy et al. references.

By contrast, the Reddy et al., references teach a process wherein crystalline nanoparticles were obtained only after air drying the samples at 80 -100°C, followed by a calcination step at 300-400°C. Thus, by virtue of the claimed process applicants are able to avoid the particle growth and agglomeration which characterizes the processes of the Reddy et al. references and which results from treatments at elevated temperature. Accordingly, the instantly claimed product has a smaller particle size (1-5 nm) with a higher surface area (200-250 m<sup>2</sup>/gm) than the Reddy et al. product. By using a temperature range limited to 20-45°C, applicants avoid unwanted growth in particle size, while maintaining the surface area in the range 200-250 m<sup>2</sup>/gm. Moreover, the Reddy et al. reference documents and discloses nanoparticles of an average crystallite size of 3-10 nm as against applicants claimed titanium dioxide having a particle size of 1-5 nm. (See in this regards claims 1-6 and 11.) It should be noted that crystallite size and particle size are, in principle, different from each other. It certainly implies that the particle size obtained by Reddy et al. is quite different from the instantly claimed products.

It is respectfully submitted that claims 1-6, 8 and 10-12 distinguish over the teachings of the Reddy et al. references and, accordingly, the rejections under §102(b) and §103(a) have been overcome and should be withdrawn.

Claim 9 stands rejected under 35 USC section 103(a) as being unpatentable over the 2001 and 2002 articles by Reddy et al. This rejection is respectfully traversed.

With respect to the claimed step of freeze drying, it should be pointed out that the by-product, hydrazine monhydrochloride, is a deliquescent salt which is a solid at room temperature. It is extracted from the filtrate by freeze drying in the range of -60 to -40°C, inasmuch as the material is extremely sensitive to heat. The objective of the Reddy et al. references was only to prepare nanocrystalline anatase titanium dioxide nanoparticles and to study their properties.

By contrast, the claimed invention is directed to the development of an environmentally benign process for the simultaneous preparation and production of nanocrystalline anatase titanium dioxide and hydrazine monhydrochloride. Hence, claim 9 recites a specific requirement in the process for isolating hydrazine monhydrochloride. Accordingly, the rejection having been overcome it should be withdrawn.

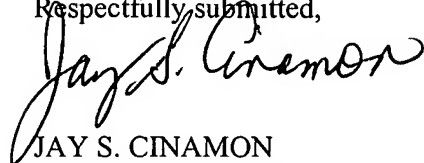
Claim 7 stands rejected for obviousness under section 103(a) over the combination of the 2002 article by Reddy et al. and Okusako, US 2002/0051746 or the 2001 article by Reddy combined with Okusako. This rejection is respectfully traversed.

In the articles by Reddy et al. and the published application of Okusako one of ordinary skill in the art is taught the process of calcination, either in the presence of air and/or nitrogen, which essentially means treating the material at elevated temperatures. It should be noted by the Examiner that the merit of claimed process rests on the fact the nanocrystalline titanium dioxide, synthesized as recited in claims 1-12, is carried out at temperatures in the range of 20-45°C and does not involve treatments at elevated temperatures. It is respectfully submitted that this rejection has been overcome and accordingly should be withdrawn.

The issuance of a Notice of Allowance is respectfully solicited.

Please charge any other fees which may be due and which have not been submitted herewith to our Deposit Account No. 01-0035.

Respectfully submitted,

A handwritten signature in black ink, reading "Jay S. Cinamon". The signature is fluid and cursive, with the first letters of the first and last names being capitalized and prominent.

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